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(54) SYSTEM, METHOD, AND APPARATUS FOR ESTIMATING LIQUID DELIVERY

(71) Applicant: **DEKA Products Limited Partnership**, Manchester, NH (US)

(72) Inventors: **Dean Kamen**, Bedford, NH (US); **John M. Kerwin**, Manchester, NH (US); **Colin H. Murphy**, Cambridge, MA (US)

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(57) **ABSTRACT**

A pump includes a reservoir, a port, and a plunger. The reservoir delivers a liquid by discharging the liquid through the port coupled to the reservoir. A piston of the plunger defines a liquid side of the reservoir and a non-liquid side of the reservoir whereby movement of the plunger towards the liquid side of the reservoir discharges liquid through the port. The pump also includes a reference-volume assembly and/or a linear position sensor. The reference-volume assembly is coupled to the reservoir at an opposite end of the reservoir relative to the port and includes a reference-volume chamber in acoustic communication with the non-liquid side of the reservoir, a speaker disposed within the reference-volume chamber, and a reference microphone disposed within the reference-volume chamber. The pump estimate the amount of liquid discharged from the reservoir.